Journal of Plantation Crops 12 (2): 133-139 December, 1984

DISTRIBUTION PATTERN OF HEAVY METALS IN COCONUT CROWN UNDER ROOT (WILT) DISEASED AND HEALTHY CONDITIONS*

C. C. BIDDAPPA
Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala, India

ABSTRACT

The heavy metal contents in the coconut crown was evaluated both in root (wilt) diseased and healthy coconut palms. The studies indicated that the concentration of Cr, Pb, Ba, Bi, Ga, Sr and Li were significantly higher in the diseased palms. The localisation and translocation of heavy metals in different leaf positions are primarily dependent on nature of the metal ion itself.

INTRODUCTION

The root (wilt) disease of coconut has been attributed to the involvements of various biotic factors such as fungi (Thomas Joseph, 1978), bacteria (Srivastava, Shekhawat and Rao 1969), virus (Summanwar et al, 1969) and nematode (Khan et al, 1971) and the nutritional disorder (Cecil, 1975) However, in recent past, the direct or indirect participation of these factors in the disease syndrome has been ruled out through systematic experimentations. Of late, the presence of mycoplasma like organisms (MLOs) has been implicated in the root (wilt) disease of coconut palm, though its role in the expression of the disease has yet to be established.

Varghese, Sankaranarayanan and Menon (1957) ruled out the involvement of Sr in the incidence of root (wilt) disease. However, Biddappa (1984) has demonstrated high concentration of certain heavy metals in the cabbage and root tissue of diseased coconut palm by employing scanning electron x-ray microprobe technique. It has been hypothesized that either the high concentration of certain heavy metals or deficiencies of certain others in the diseased coconut palms might induce derrangement of physiological processes besides rendering imbalances in the plant nutrients. Thus the metal toxicity could be related to the disease syndrome to a large extent. The distribution pattern of heavy metals in the coconut crown under diseased and healthy condition is of great significance in understanding the nature of the disease.

The present paper primarily deals with the distribution pattern of certain heavy metals in different leaf position

* *Contribution No. 331. Central Plantation Crops Research Institute, Kasaragod 670 124, Kerala, India.*

of diseased and healthy coconut palms collected from different soil groups of Kerala.

MATERIALS AND METHODS

Forty leaf samples each from leaf positions 1, 4, 9 and 14 from diseased palms in Alleppey district and healthy palms from Kasaragod area of Cannanore district, representing laterite, river alluvium and sandy soils were collected. The leaf samples were washed with acidified water followed by running tap water and distilled water. The Samples were dried in oven at 60°C powdered and digested in diacid (1:2, perchloric: nitric acid). The heavy metals content were estimated by atomic absorption spectrophotometer. The data were statistically analysed for interpretation.

RESULTS AND DISCUSSION

The data pertaining to certain heavy metal concentration in different leaf positions have been summarised in Tables I to IV. The results revealed that Cd content in the coconut leaves ranged from 0.99 to 5.79 ppm (Table I). However, among the healthy and diseased leaves no significant variation was observed. On the other hand, the diseased leaves tend to contain relatively higher concentration than the healthy leaves irrespective of leaf position sampled. Although different soils did not significantly influence the Cd content of the crown, the laterite soil supported lower uptake of Cd than the remaining soils.

Table I. *The contents of Cd, Cr and Co in different leaf positions of diseased and healthy palms sampled from different soils (μg/g)*

Soils	D/H	Heavy Metals											
		Cd				Cr				Co			
		First leaf	4th leaf	9th leaf	14th leaf	First leaf	4th leaf	9th leaf	14th leaf	First leaf	4th leaf	9th leaf	14th leaf
Sandy	Diseased	2.34	3.88	5.31	2.68	26.75	23.00	20.50	12.12	1.00	0.24	08.0	0.75
	Healthy	2.85	2.48	3.40	5.79	6.62	6.25	9.70	7.12	4.00	2.12	4.00	4.62
Laterite	Diseased	1.99	2.62	2.55	2.16	13.25	20.88	39.60	8.75	0.12	0.50	1.80	2.28
	Healthy	2.12	3.21	0.99	1.70	9.50	9.00	4.10	7.12	2.88	2.02	1.50	2.75
Alluvial	Diseased	4.02	2.85	1.82	2.18	28.50	28.00	28.00	5.88	2.00	2.62	2.10	1.88
	Healthy	2.80	2.58	2.02	3.81	6.75	8.38	6.70	7.50	2.38	2.50	1.50	1.25
CD for soils		NS	NS	NS	1.73*	NS	NS	7.14*	NS	NS	NS	NS	NS
CD for D/H		NS	NS	NS	NS	14.80**	12.45**	16.28**	NS	1.10*	0.98*	1.32**	1.15*
CD for soils×D/H		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1.99*

The Cr content (Table I) in the diseased palm in general was significantly more than healthy palm in all the leaf positions sampled barring 14th leaf. However, different soil types did not significantly influence the Cr uptake by the coconut. The Co content in the healthy leaves is relatively more than the diseased ones. Neither soils nor the interaction between soil and the diseased status affected the Co uptake.

The Ba contents (Table II) in the leaves of diseased palm was significantly higher than the healthy palms barring the first leaf. The magnitude of variation was to the extent of 3–4 folds among them. The variability in the soil was found to influence in the Ba content of 4th and 14th leaf significantly than first and 9th leaf. While comparing the soils, it was evident that the laterite soil in general rendered relatively lower uptake of Ba than the remaining two soils. Bi content (Table II) of the first leaf varied significantly among soils while laterite soils supported very low values. The variation between diseased and healthy leaves was not reflected from the data. However, in the 9th leaf the content was significantly more under diseased condition. The variation between diseased and healthy leaves was not reflected from the data. However in the 9th leaf, the content was significantly more under diseased condition. The variation in the content of Bi between diseased and healthy leaves or among the soils has narrowed considerably with the maturity of the leaves.

Table II. *The contents of Ba, Bi and Ga in different leaf positions of diseased and healthy palms sampled from different soils (μg/g)*

		Heavy Metals													
		Ba				Bi				Ga					
Soils	D/H	First leaf	4th leaf	9th leaf	14th leaf	First leaf	4th leaf	9th leaf	14th leaf	First leaf	4th leaf	9th leaf	14th leaf
Sandy	Diseased	17.25	15.38	20.25	23.38	13.62	17.38	15.25	16.12	14.25	18.10	28.00	24.38
	Healthy	7.12	3.38	4.00	6.00	7.12	11.00	12.38	11.50	9.50	3.60	0.00	6.00
Laterite	Diseased	10.00	13.38	15.12	13.62	5.62	14.62	18.25	12.75	6.75	18.30	12.12	21.50
	Healthy	14.00	7.12	5.75	4.00	4.50	4.50	10.12	15.00	5.62	6.30	4.75	3.00
Alluvial	Diseased	16.12	25.50	24.12	32.12	21.38	21.25	22.12	19.38	0.00	11.40	0.00	0.00
	Healthy	9.62	10.25	9.00	8.50	17.62	15.25	12.38	12.88	0.38	5.30	3.25	5.25
CD for soils		NS	6.85**	NS	6.68**	7.41**	6.67**	NS	NS	NS	NS	9.48**	NS
CD for D/H		NS	5.60**	7.41	5.45	NS	5.45**	6.99	NS	NS	4.68**	7.74**	9.50**
CD for soils × D/H		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

The results pertaining to Ga (Table II) have indicated that first leaf does not show significant difference between diseased and healthy palms. However, a marked variation has been exhibited among soils as well as diseased status with the maturity of leaf. The diseased palm leaves invariably contained higher Ga content than healthy leaves. The Ni content (Table III) in the 14th leaf showed significantly higher concentrations in the diseased leaf. The influence of soils and their interaction was significant only for the 14th leaf.

Although the Li content (Table III) in the diseased palm was relatively more than the healthy, the difference was not significant. It is also evident from the results that the laterite soil supported least uptake of Ni compared to sandy and alluvial soils. The results of Pb content (Table III) in the crown revealed that the leaves of the diseased palms irrespective of leaf maturity contained higher amount of pb than the healthy leaves. However, the influence of soil was reflected significant only in the Pb content of first leaf. The interaction between soils and diseased status was significant for the first leaf concentration. In general, laterite soil supported lower uptake of Pb by the coconut compared to remaining soils.

The Sr content in the first and the 4th leaf was not significantly different between diseased and healthy palms and among soils (Table IV) while markedly high concentration of Sr in 9th and 14th

Table III. *The contents of Li, Ni and Pb in different leaf positions of diseased and healthy palms sampled from different soils (μg/g)*

Soils	D/H	Heavy Metals											
		Li				Ni				Pb			
		First leaf	4th leaf	9th leaf	14th leaf	First leaf	4th leaf	9th leaf	14th leaf	First leaf	4th leaf	9th leaf	14th leaf
Sandy	Diseased	0.29	0.62	0.78	0.70	11.25	12.62	9.00	7.12	1.00	3.62	5.00	5.50
	Healthy	0.34	0.52	1.29	2.38	8.38	9.25	12.25	10.38	4.00	0.75	1.25	2.38
Laterite	Diseased	0.22	0.36	0.65	0.84	6.62	5.50	8.25	7.50	0.12	3.12	6.88	3.12
	Healthy	0.34	0.38	0.31	0.46	9.00	6.00	4.25	6.09	2.88	0.62	0.88	0.75
Alluvial	Diseased	0.52	0.50	0.62	0.68	14.50	10.50	6.88	6.25	2.00	5.25	2.88	4.88
	Healthy	0.22	0.24	0.31	0.66	6.38	10.75	5.62	6.62	2.38	0.95	0.00	2.75
CD for soils		NS	NS	0.45*	0.43**	NS	NS	3.73**	NS	1.15**	NS	NS	NS
CD for D/H		NS	NS	NS	0.35*	NS	NS	NS	NS	0.45*	1.81**	2.11**	1.87*
CD for soils × D/H		NS	NS	NS	0.61**	NS	NS	NS	NS	1.64**	NS	NS	NS

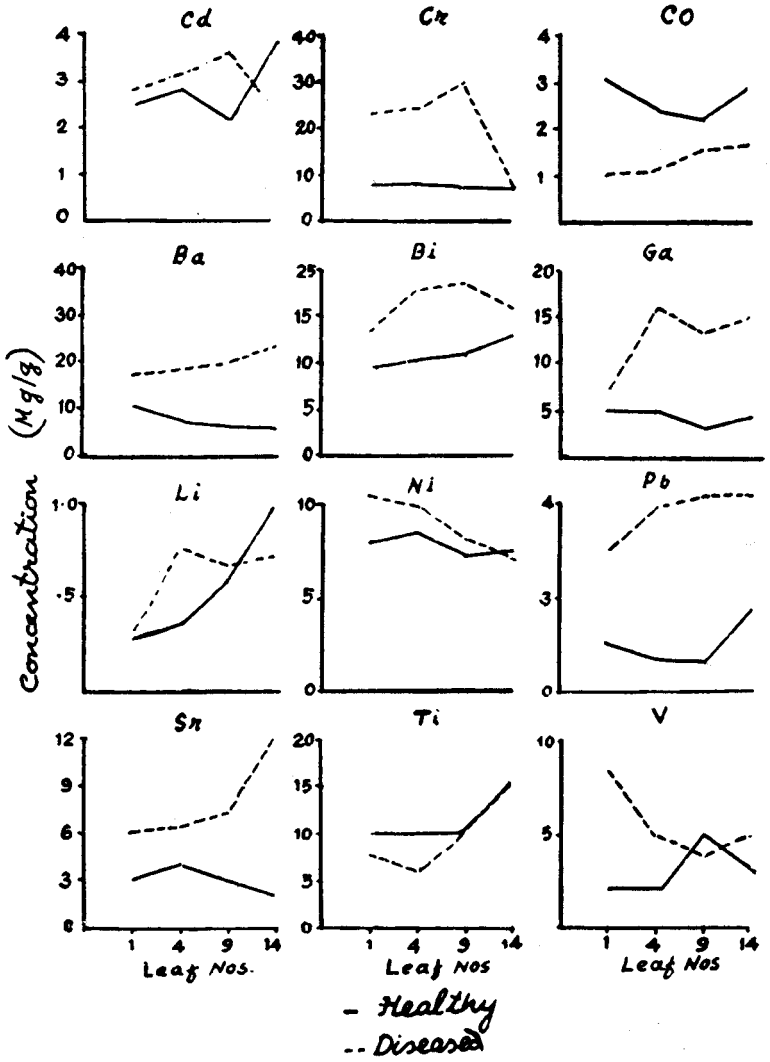
leaf of diseased palms have been recorded. The influence of soil types on the Sr content of older and matured leaf and the interaction between soil and diseased condition was also highly significant. The Ti and V content (Table IV) did not show significant variation among soil as well as between healthy and diseased palms irrespective of leaf position.

The dynamics of heavy metal concentration in the coconut crown with the maturity of the leaves is presented in Fig. I. The pattern of change in the concentration of heavy metals with the maturity of leaves was found to be quite different among diseased and healthy tissues. The Cd content in the diseased leaves increased upto 9th leaf and decreased thereafter. However in healthy the Cd content decreased upto 9th leaf and increased thereafter. The Cr content in the healthy leaves remained almost constant with the age of the leaves whereas the diseased palm showed initial increase before dropping down at 14th leaf. The content of Ba, Bi, Ga, Pb, Sr and Ti increased with the age of the leaves under diseased conditions while that of Ni decreased. In the case of Li and Ti, and the healthy leaves showed progressive accumulation with the age of the leaves, while the Ni content both in diseased and healthy leaves decreased with maturity of the leaves. This clearly shows the nature of the translocation of these metal ions under derranged physiological processes in the diseased palms. The healthy leaves showed a different pattern of change with the age of the leaves.

Table IV. *The contents of Sr, Ti and V in different leaf positions of diseased and healthy palms sampled from different soils (μ/g)*

Soils	D/H	Heavy Metals											
		Sr				Ti				V			
		First leaf	4th leaf	9th leaf	14th leaf	First leaf	4th leaf	9th leaf	14th leaf	First leaf	4th leaf	9th leaf	14th leaf
Sandy	Diseased	5.75	7.50	6.62	11.75	12.50	10.00	11.25	18.25	0.00	0.00	0.00	1.25
	Healthy	3.88	7.62	5.88	1.62	12.50	6.25	11.25	26.25	2.50	2.50	3.75	1.25
Laterite	Diseased	3.00	1.38	3.00	5.25	1.25	3.75	8.75	12.50	1.25	12.50	11.25	8.75
	Healthy	4.25	4.88	1.75	2.25	6.25	8.75	7.50	7.50	3.75	1.25	10.00	5.00
Alluvial	Diseased	9.25	10.25	12.00	19.00	10.00	3.88	11.25	13.62	25.00	2.50	0.00	5.00
	Healthy	3.25	2.38	1.62	2.88	11.25	15.00	11.25	15.00	0.00	2.50	2.50	3.75
CD for soils		NS	NS	3.45**	4.53**	NS	NS	NS	NS	NS	NS	NS	NS
CD for D/H		NS	NS	2.82**	3.75**	NS	NS	NS	NS	NS	NS	NS	NS
CD for soils × D/H		NS	NS	4.89**	6.42**	NS	NS	NS	NS	NS	NS	NS	NS

FIG. 1. DYNAMICS OF HEAVY METAL CONCENTRATION IN COCONUT CROWN



REFERENCES

BIDDAPPA, C. C. 1984. Identification of heavy metal deposits in the roots of root (wilt) diseased coconut palm by using scanning electron X-ray microprobe analyser. *Plant and Soil.* (in press).

CECIL, S. R. 1975. Mineral composition of coconut leaves in relation to root (wilt) disease. *J. Plant. Crops.* 3: 34–37.

KHAN, E., SESHADRI, A. R., WEISCHER, B. and MATHEN, K. 1971. Five nematode species associated with coconut in Kerala, India. *Indian J. Nematol.* 1: 116–127.

SRIVASTAVA, D. N., SHEKHAWAT, G. S. and RAO, Y. P. 1969. Association of bacteria with root (wilt) of coconut in Kerala. *Indian J. Agric. Sci.* 39: 395–396.

SUMMANWAR, A. S., RAYCHAUDHURY, S. P. JAGADHISH CHANDRA, K., NAMPRAKASH and LAL, S. B. 1969. Virus associated with coconut root (wilt) disease. *Curr., Sci.* 38: 208–210.

THOMAS JOSEPH. 1978. Some fungi associated with the root (wilt) system of coconut in the root (wilt) affected areas. *Curr. Sci.* 47: 586–587.

VERGHESE, E. J., SANKARANARAYANAN, M. P. and MENON, K. P. V. 1957. Strontium content of coconut leaves and soils in relation to the leaf and root (wilt) disease of coconut in Travancore–Cochin. *Indian Cocon. J.* 10: 25–31.